Biology enters the scene

Biology enters the scene – a new perspective on bilingualism, cognition and dementia

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An editorial to accompany Estanga et al in Neurobiology of Ageing

Abstract

The question of whether bilingualism can influence cognitive functions in healthy ageing as well as in brain diseases is currently a topic of an intense debate. In a study published in this issue of the "Neurobiology of Ageing" Estanga et al are breaking new ground by combining cognitive and biological approaches. Based on the data from the Guipuzkoa Alzheimer Project, they report that, compared to monolinguals, early bilinguals are not only characterized by a better cognitive performance in several domains and a lower prevalence of Alzheimer's Disease, but also by lower levels of t-tau in their CSF. We suggest that sustained activation of noradrenergic signaling pathways associated with bilingualism could provide a possible mechanism linking results of this study with previous observations of delayed onset of dementia in bilinguals.

Keywords: bilingualism, Alzheimer Disease, cognitive reserve, noradrenergic pathways

Debate is at the very heart of scientific progress. It can stimulate new findings, lead to refinement of existing theories and to creation of new ones. It can inspire. But not every debate is equally productive and edifying. Some, instead of generating new ideas, lead to the same arguments being reiterated again and again, louder, but not necessarily more convincing. It can lead to both sides getting more entrenched in their own argumentation rather than learning from each other.

The debate about possible "bilingual advantage" in cognitive functions has been recently in the danger of entering this route (Bak, 2016a). Undoubtedly, the evidence at the moment is contradictory: some studies find significant positive effects of bilingualism on cognitive ageing (Kavé et al., 2008, Bak et al., 2014), dementia (Alladi et al., 2013, Woumans et al., 2015) and stroke (Alladi et al., 2016); others do not find comparable results (Clare et al., 2014, Zahodne et al., 2014, Clare et al., 2016). It is not the question of group size or methodological rigour, as large, well designed and thoroughly analysed studies can be found on both sides of the debate. So what can explain the discrepancy?

Often, the best solution to a protracted problem comes from outside. As useful and important as the current psycholinguistic debate about the exact nature of different executive tasks might be, new insights could be won by extending the research questions to encompass other disciplines and methodologies. One direction could point towards the society in which the researchers and their participants live, and the consequent social, political and ideological context of bilingualism (Bak, 2016b).

The other direction would be to embrace biology and explore whether effects of bilingualism could be detected not only at the anatomical level of brain regions, as identified by neuroimaging (Bialystok et al., 2016), but also the basic level of neurotransmitters, synapses, proteins and biomarkers. The paper by Estanga et al (in this volume) is a significant step in this direction. The study, based on the data from the Guipuzkoa Alzheimer Project, has not only observed a better cognitive performance and a lower prevalence of preclinical Alzheimer's Disease (AD) in bilingual subjects. Importantly, early bilingualism was also associated with lower t-tau levels in the CSF.

This result does not come out of the blue. Noradrenergic stimulation of locus coeruleus, one of the brain regions showing earliest tau-pathology (Grudzien et al., 2007), has been implicated as one of the potential mechanisms of cognitive reserve (Robertson, 2013). More recently, locus coeruleus TH+ neurons were shown to mediate post-encoding memory enhancement, possibly through a co-release of dopamine in the hippocampus (Takeuchi et al., 2016), another structure of crucial importance for AD. If we consider bilingualism to be one of the forms of cognitive reserve we should expect to find biological as well as cognitive differences between mono- and bilingual subjects. Indeed, biological characteristics of bilingualism might be detectable even when the influence of other variables could obscure the cognitive ones.

All studies of bilingualism are constrained by the specific features of the investigated populations (Bak, 2016b) and this one was no exception. Critics will point out that it was not possible to match both groups for education and occupation, although the authors did adjust for these variables. Interestingly, the bilinguals were not better on all cognitive tests; early bilinguals performed in fact worse than monolinguals on picture naming, exactly as could be expected from previous studies showing bilingual disadvantages in lexical access (de Bruin et al., 2016). Commendably, the focus on biology did not prevent the authors from discussing the social background and linguistic characteristics of bilingualism in the Basque Country, showing that social, linguistic and biological perspective are not mutually exclusive but complementary.

This is just the beginning of a very long road. We need more studies of this type, more biomarkers, different methodologies, new populations. We need to expand our theories of bilingualism all the way from proteins and neurotransmitters to cultures and societies. But the first step has been done.

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